Physical Therapy Examination and Management for a 48-year-old Active Military Patient During the Maximum Protection Phase of ACL Reconstruction Rehab: A Case Report

By

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Abstract

Background and Purpose:

Anterior Cruciate Ligament (ACL) tears are one of the most commonly treated orthopedic injuries. Individuals participating in high-demand sports or activities are at higher risk for ACL injury, including active military personnel. Post-surgical protocols with criterion-based phases have been established to promote effective physical therapy rehabilitation for eventual full return to activity. However, many factors can affect the outcomes after an ACL reconstruction. The purpose of this case report is to present the physical therapy examination and management for a patient during the Maximum Protection Phase of ACL reconstruction rehab and discuss factors that could affect prognosis and outcome, including military background and status, concomitant injury, time to surgery, and age.

Case Description:

A 48-year-old male active-duty Army sergeant was referred to outpatient orthopedic physical therapy clinic for post-operative management after undergoing a left ACL reconstruction with an anterior tibialis tendon allograft, lateral meniscus arthroscopy, and medial femoral condyle and patellar chondroplasty. Prior to surgery, he had experienced worsening, chronic left knee pain for three years that limited his military duties and recreational activities.

Outcomes:

The patient made notable improvements in swelling, knee range of motion (ROM), quadriceps activation, and gait through physical therapy intervention targeting these impairments.

Additionally, he was able to tolerate progressions to closed kinetic chain (CKC) strengthening and Blood Flow Restriction (BFR).

Discussion:

Physical therapy intervention was beneficial in improving early post-operative impairments regardless of prognostic factors, including concomitant injury, age, time to surgery, or military status. Further research is needed to assess the effect of these factors on outcomes beyond the Maximum Protection Phase of rehab.

Key Words: Anterior Cruciate Ligament Reconstruction, Physical Therapy, Maximum Protection Phase, Military

Introduction

Isolated Anterior Cruciate Ligament (ACL) tears are one of the most common orthopedic injuries, with an annual incidence of 68.6 per 100,000 people, and ligament reconstruction surgery to address the ACL deficient knee is the sixth most common orthopedic surgery performed[1,2]. Injuries of the menisci and cartilage can accompany ACL tears, either occurring at initial injury or developing over time, as chronic ACL insufficiency has been found to contribute to meniscal and chondral pathology[3].

Highschool aged athletes and young adults participating in high demand athletic activities have been identified as high-risk groups for ACL injury[1]. Military personnel are another demographic that experience a larger incidence of ACL injuries compared to the general population with ACL reconstruction being one of the most common orthopedic procedures performed in military members[2,4].

ACL injury is a highly studied topic in both realms of orthopedic medicine and physical therapy. Post-operative physical therapy protocols have been well-studied and established for use in the outpatient setting[5]. A systematic review performed in 2016 recommended physical therapy treatment after ACL reconstruction should include "3 criterion-based postoperative phases: (1) impairment-based, (2) sport-specific training and (3) return to play."[6] The impairment-based phase of rehab includes the first week after surgery to approximately eight weeks post-operative and focuses on regaining knee ROM, improving quadriceps function, and normalizing gait[5]. The name of this early phase after surgery varies depending on literature, though will be referred to as the Maximum Protection Phase throughout this report as this terminology is consistent with the surgeon-established rehab protocol used in this study.

As with other orthopedic surgical procedures requiring physical therapy, many factors may contribute to the rehabilitation outcomes after an ACL reconstruction surgery. This case report aims to present the evidence-based physical therapy examination and plan of care for a patient during the Maximum Protection Phase of ACL reconstruction rehab and discuss factors that could affect prognosis and outcome, including military background and status, concomitant injury, time to surgery, and age.

Case Description

The patient was a 48-year-old male referred to outpatient physical therapy at Austin Sports Medicine North PT Clinic following a left anterior cruciate ligament repair (ACLR) using an anterior tibialis allograft on June 30, 2021. In addition to the ACLR, he also underwent a partial lateral meniscectomy and chondroplasty of the medial femoral condyle and patella. Procedures were performed by Dr. Douglas Elenz, a surgeon employed by Austin Sports Medicine (ASM). At time of initial physical therapy evaluation, the patient was six days post-op and experiencing swelling and generalized soreness his left knee that was exacerbated by weightbearing, knee flexion, and terminal knee extension. He also reported difficulty with range of motion and ambulation, which were affecting his daily activities.

Upon subjective interview, the patient reported experiencing chronic left knee pain for approximately three years prior to surgical intervention. He could not pinpoint a specific moment of injury, however, suspected it occurred over time during his many required physical duties as a sergeant in the U.S Army. The patient received physical therapy treatment while stationed and living in El Paso, though reported worsening of symptoms rather than improvement. Once he moved to Austin, he received an MRI at ASM, which indicated a complete tear of the left ACL as well as cartilage and meniscal damage.

The patient had no significant past medical history or red flags and reported a very high prior level of function as a sergeant in the U.S army and employment as a dental lab technician. Additionally, he participated in many high-level recreational activities, including weightlifting, Cross Fit, martial arts, running, hiking, and cycling, all of which had become limited by his chronic knee pain.

Examination

Body anthropometrics were gathered from the patient's medical records in the EMR software utilized by ASM. The patient's weight and height were documented as 260 pounds and 71 inches respectively, which calculated to a BMI of 38.39. The patient arrived to the initial physical therapy session using bilateral crutches and demonstrating a swing-to gait pattern with his knee brace locked into 0 degrees of knee extension. Incision sites were observed to be clean with Steri-Strips in place and no abnormal erythema or exudate. He reported 5/10 pain on the Numeric Pain Rating Scale (NPRS) and scored a 72.5% impairment in the Lower Extremity Functional Scale (LEFS), a subjective outcome questionnaire. Upon physical therapy examination, the patient demonstrated knee effusion, indicated by a positive Sweep Test and increased knee girth measurements compared to unaffected right limb. Both active and passive knee range of motion (ROM) were reduced and hesitancy to move into knee flexion was observed. Hip and ankle active ROM were within normal limits bilaterally. Quadriceps activation was observed to be diminished and a 12-degree extension lag was measured during an active straight leg raise. Weightbearing tolerance was decreased with soreness reported during a lateral weight shift to the affected limb. Palpation to medial and lateral joint lines and the superior patellar pole elicited mild pain. All examination findings are summarized in detail in Table 1.

Diagnosis and Prognosis

The findings of the objective examination were consistent with deficits expected after ACL reconstruction, including pain and decreased ROM and quadriceps function resulting in limitations in functional mobility and recreational activities[7]. Frequency of physical therapy

intervention was established for twice weekly and expected to continue for approximately 9-12 months in total for eventual full return to high-level activity required of the patient as a sergeant in the U.S Army. Prognosis and the rehab timeline were based upon the ACL reconstruction protocol established by the surgeons at ASM as well as current literature that suggests rehab should include criterion-based post-operative phases[6]. Other prognostic factors considered were the patient's military background, chronic ACL insufficiency and prolonged time before surgery, and concomitant injuries.

Intervention

The focus of this report was the Maximum Protection Phases of rehab, which encompass the first eight weeks after surgery. Interventions were aimed at addressing identified impairments, including pain, swelling, ROM, strength, and gait, while maintaining post-operative precautions. Neuromuscular Electrical Stimulation (NMES) of the quadriceps muscle in combination with exercise was initiated on the initial visit and continued throughout 12-visit episode of care to improve quadriceps engagement, gain terminal knee extension, and reduce muscle fiber atrophy that can occur with ACL reconstruction[7,8]. The patient was also educated on electrode placement and proper use of the NMES unit for utilization with his prescribed home exercise program. Early weightbearing activities, including weight shifting and heel raises, and education on restoration of normal gait mechanics was also emphasized on the initial visit to prevent quadriceps and gastrocnemius atrophy and improve functional mobility[9]. Manual therapy techniques were tailored to address restrictions or deficits identified each session. Interventions were progressed per the surgeon's post-operative protocol and patient performance and tolerance. Blood Flow Restriction (BFR) was initiated on the tenth visit at five weeks post-operative status, as it is a promising tool in improving strength after knee injuries in which high load is contraindicated[9]. The BFR protocol used was 80% limb occlusion with one set of 30 reps followed by three sets of 15 reps with a 30 second rest break between each set. BFR was combined with NMES on the twelfth visit to potentially enhance hypertrophy of the quadriceps[10]. All interventions and progressions, including manual therapy, therapeutic exercise, therapeutic activity, and neuromuscular reeducation, are listed in Table 2.

Outcomes

The patient was treated twice a week for five weeks before the first reassessment performed on the tenth visit. He was then seen for an additional two visits before the conclusion of data collection, though continues to receive treatment. Objective findings at the initial evaluation and reassessment are summarized in Table 3. The most notable improvements were observed in knee active ROM with the patient able to achieve 0 degrees of knee extension and 116 degrees of knee flexion. Quadriceps strength was not formally measured, however, improvements in single leg control were observed through a modified Piva Heel Tap Test and Single Leg Balance Test. Additionally, due to improvements in quadriceps control, bilateral crutches were discharged, and the patient's brace was unlocked. He presented with a more normalized gait pattern, though still demonstrated a slower gait speed and hesitancy with loading response. An extensor lag was still present during an active straight leg raise with only a 1 degree decrease from initial evaluation. Improvements in swelling were noted with a decrease in knee girth measurements by at least 0.5 cm from initial measurements.

Over the course of treatment, the patient responded well to progressions overall and reported adherence to his prescribed home exercise program. He reported mild soreness after the initiation of BFR, though this was expected and resolved within two days[11]. Only one minor setback occurred on the fourth visit in which the patient arrived to therapy and reported increased soreness in his knee after a rapid jerking motion of his hip and knee in order to catch it from falling off his bed. Non-weightbearing modifications were made to treatment that session. Fortunately, the patient was scheduled for his second post-operative visit with his surgeon the following day and graft injury was ruled out. There were no other adverse responses throughout the 12-week episode of care.

Discussion

Post-operative physical therapy intervention during the Maximum Protection Phase after ACL reconstruction was successful in improving swelling, ROM, quadriceps activation, and gait of a 48-year-old male active-duty Army sergeant. The accomplishment of these goals is indicative the patient is ready to advance to the next stage of rehab[12]. While the patient was able to achieve full knee extension in long sitting and with CKC terminal knee extension, he continued to demonstrate an extension lag with hip flexion against gravity, indicating a deficit in quadriceps endurance. Impairments in quadriceps strength and endurance compared to the unaffected limb can persist for six months or greater after ACL reconstruction and, based upon the time required for muscle hypertrophy to occur, it is not realistic for full return of quadriceps strength in this timeframe[13].

Prognostic factors considered when developing the plan of care (POC) were the patient's age, concomitant injures, time to surgery, and his requirement to return to a high level of activity as an Army sergeant. While these factors have not adversely affected the patient's rehab thus far, it is unknown if they will influence outcomes beyond the initial phase of rehab, in which the knee is further challenged to accept greater loads and generate larger forces in sport-specific activities. Literature varies on whether age affects ACL reconstruction outcomes[14,15]. Chronic ACL insufficiency, or length of time from injury to surgery, has been found to increase the risk for concomitant cartilage and meniscal injuries, however, after reconstruction, outcomes regarding quadriceps strength and performance on return to sport testing are similar to patients with isolated ACL tears and subsequent reconstruction[16,17,18]. Lastly, before the patient approaches return to sport and discharge, it is important to consider the physical requirements for return to military duty as recent literature has found that "more than 50% of active duty military members

who undergo ACLR require permanent activity restrictions and/or removal from active duty service"[19].

Limitations

While the Maximum Protection Phase was the focus of this report, this small timeframe is also a limitation. The effects of isolated BFR as well as BFR in combination with NMES were unable to be assessed for this report. However, adhering to the surgeon's protocol and considering literature on the timeframe for return to high-level activity, the patient is expected to continue physical therapy for the next eight months, in which time benefits of the BFR protocol may be seen.

Conclusion

In summary, this case report demonstrated that early physical therapy intervention post-ACL reconstruction is beneficial in addressing impairments in swelling, ROM, quadriceps activation, and gait regardless of concomitant injury, age, time to surgery, or military status. However, additional research is recommended to investigate if these factors affect outcomes further along in rehab or after the patients have been discharged.

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Tables and Figures

Table 1: Initial Examination Objective Findings

Knee ROM	Pain	Knee Girth	Extensor Lag	Sweep Test	Gait
5d ext 75d flex	5/10	Superior Patellar Pole: 47.5 cm Mid Patella: 45cm Inferior Patellar Pole: 42.5cm	12 d lag	Positive	NWB w/ bilateral crutch and brace locked in extension

Table 2: Interventions (Initial Visit to 12th Visit)

Visit	Manual Therapy	Therapeutic Exercise	Therapeutic Activity	Neuromuscular Reeducation
1	N/A	Heel slides: 2x10 Calf raise w/ brace: 3x10	Lateral weight shifts w/ brace: 3x10	Quad Set (+) NMES: 3 min SLR 4-way (+) NMES: 3 min ea Prone TKE (+) NMES: 3 min
2	IASTM to distal HS and proximal gastroc	Heel slides: 3x10 Multi-angle quad isometrics, 90 and 45 d (+) NMES: 10”x10 Calf raise w/ brace: 3x10	Gait Training: pt education on gait instructions w/ 3-point pattern w/ B crutches Lateral and staggered WS w/ brace: 3 min ea	Quad Set (+) NMES: 3 min SLR 4-way (+) NMES: 3 min ea Prone TKE (+) NMES: 3 min
3	IASTM to distal HS and proximal gastroc Scar mob to healed incisions Wound care/replaced steristrips	Heel slides: 3x10 Multi-angle quad isometrics, 90 and 45 d (+) NMES: 10”x10	Gait Training: pt education on gait instructions w/ single crutch TG Bilateral Squat w/ brace: L2 1x10 Lateral and staggered WS w/ brace: 20x ea	Quad Set (+) NMES: 10”x10 SLR 4-way (+) NMES: 2x10 ea
4	Edema Reduction Cupping w/ tissue distraction medial knee joint line PROM L knee	Heel slides: 3x10 Multi-angle quad isometrics, 90 and 45 d (+) NMES: 10”x10	N/A	Quad Set (+) NMES: 10”x10 SLR 4-way (+) NMES: 2x10 ea Prone TKE (+) NMES: 10”x10

5	Edema Reduction IASTM peripatellar complex PROM L knee	Heel slides: 3x10 Multi-angle quad isometrics, 90 and 45 d (+) NMES: 10”x10	Gait Training: pt edu gait instructions w/ single crutch TG Bilateral Squat w/ brace: L2 3x10	Quad Set/SAQ (+) NMES: 3 min ea SLR flexion (+) NMES: 2x10 Standing Banded TKE (+) NMES: 10”x20 Bilateral balance on blue fitter board: 30”x3
6	Edema reduction Scar massage PROM L knee	Bike for ROM stimulus: 6min Multi-angle quad isometrics, 90 and 45 d (+) NMES: 10”x10 HS/ITB stretch: 20”x3	Gait Training: over small hurdle 6 laps; stride practice TG Bilateral Squat w/ brace: L2 3x10	SLR flexion (+) NMES: 2x10 Standing Banded TKE step up (+) NMES: 2in, orange resistance band, 3x8 Bilateral balance on blue fitter board: 30”x3
7	Edema reduction Scar massage PROM L knee	Bike for ROM stimulus: 6min Multi-angle quad isometrics, 90 and 45 d (+) NMES: 10”x10 HS/ITB stretch: 20”x3 TRX slider lunge: 3x5	Gait Training: over small hurdle 6 laps; stride practice TG Bilateral Squat w/ brace: L2 3x10	SLR flexion (+) NMES: 2x10 Standing Banded TKE step up (+) NMES: 2in, orange resistance band, 3x8 Bilateral balance on blue fitter board: 30”x3
8	Edema reduction Scar massage IASTM to medial PF PROM L Knee	Bike for ROM stimulus: 6min Multi-angle quad isometrics, 90 and 45 d (+) NMES: 10”x10 HS/ITB stretch: 20”x3 TRX slider lunge: 3x8	Ankle quadrant: orange resistance band 10x ea TG Bilateral Squat and staggered squat: L3 2x10ea	SLR flexion (+) NMES: 2x10 Standing Banded TKE step up (+) NMES: 4in, orange resistance band 3x8 3-way hip kick: yellow resistance band 2x10ea
9	Edema reduction Scar massage IASTM to medial PF PROM L Knee	Bike for ROM stimulus: 6min Multi-angle quad isometrics, 90 and 45 d (+) NMES: 10”x10 HS/ITB stretch: 20”x3 TRX slider lunge: 3x5	Ankle quadrant: orange resistance band 10x ea	SLR flexion (+) NMES: 2x10 Standing Banded TKE step up (+) NMES: 4in, orange resistance band, 3x8 3-way hip kick: yellow resistance band 2x10ea

10	Edema reduction Scar massage IASTM to medial PF PROM L Knee	Bike for ROM stimulus: 6min SL hip ABD (+) BFR: 30, 15, 15, 15 LAQ (+) BFR: 30, 15, 15, 15 TG Bilateral Squat (+) BFR: 30, 15, 15, 15 HS/ITB stretch: 20”x3	Ankle quadrant: orange resistance band 10x ea	Single leg balance on egg: 15”x3 ea
11	Edema reduction Scar massage IASTM to medial PF PROM L Knee	Bike for ROM stimulus: 6min SL hip ABD (+) BFR: 30, 15, 15, 15 LAQ (+) BFR: 30, 15, 15, 15 TG Bilateral Squat (+) BFR: 30, 15, 15, 15 HS/ITB stretch: 20”x3	Ankle quadrant: orange resistance band 10x ea	Single leg balance on egg: 15”x3 ea
12	Edema reduction Scar massage IASTM to medial PF PROM L Knee	Bike for ROM stimulus: 6min LAQ (+) BFR and NMES: 30, 15, 15, 15 TG B squat (+) BFR and NMES: 30, 15, 15, 15 Slider Lunge (+) BFR and NMES: 30, 15, 15, 15 HS/ITB stretch: 20”x3	Ankle quadrant: orange resistance band 10x ea	Single leg balance on egg: 15”x3 ea

Exercises: SLR = Straight Leg Raise, TKE = Terminal Knee Extension, LAQ = Long Arc Quad
Other Abbreviations: IASTM = Instrument Assisted Soft Tissue Massage, SL = Side-lying, HS = Hamstring, ITB = Iliotibial Band, TG = Total Gym

Table 3: Outcomes from Initial Evaluation to Reassessment

Visit	Knee ROM	Pain	Knee Girth	Extensor Lag	SL Balance (EO)	Mod. Piva Heel Tap	Gait:
1 (eval)	5d ext 75d flex	5/10	Superior Patellar Pole: 47.5cm Mid Patella: 45cm Inferior Patellar Pole: 42.5cm	12 d lag	NT due to post-op status	NT due to post-op status	NWB w/ bilateral crutch and brace locked in extension
10	0d ext 116d flex	2/10	Superior Patellar Pole: 46.5cm Mid Patella: 44cm Inferior Patellar Pole: 42cm	11 d lag	Good; 30 sec w/ no balance corrections	(performed on 4in step w/ TRX for support) <u>Score:</u> 4 (poor quality)	Brace unlocked; crutch discharged